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APPLICATION FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

Be it known that Jonathan Hitt
a citizen of GERMANY, residing at Schelztorstrasse 6, 73728 Esslingen, GERMANY
and Metin Tasdelen
a citizen of GERMANY, residing at Am Kelterplatz 17, 73265 Dettingen, GERMANY
has invented a new and useful
HEAT EXCHANGER MOUNT FRAME FOR VEHICLE
of which the following is a specification.

HEAT EXCHANGER MOUNT FRAME FOR VEHICLE

CROSS REFERENCE TO RELATED APPLICATION(S)

Not applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

Not applicable.

TECHNICAL FIELD

The present invention is directed toward heat exchanger for vehicles, and particularly toward a frame structure for supporting heat exchangers in vehicles.

BACKGROUND OF THE INVENTION AND TECHNICAL PROBLEMS POSED BY THE PRIOR ART

Frames for supporting heat exchangers in vehicles are known in the art. For example, International Patent Application WO 99/47875 discloses a U-shaped frame having guides on the inside of its two opposite arms into which a heat exchanger can be inserted, where the frame is finished into a closed frame structure by a second transverse strut. Where different size vehicles and/or heat exchangers are used, different size frame members must be used. Thus, different

manufacturing and increased inventories must be maintained to accommodate the many different sizes of heat exchangers which may commonly be used.

EP 0 020 190, from CA 1 081 277, from DE 100 61 561 A1 or from DE 195 14 016 C1 also disclose heat exchanger frame support structures. However, the above described shortcoming of WO 99/47875 is more or less true of these arrangements as well. DE 102 50 334.6 discloses a one-piece plastic frame which also is not usable with heat exchangers that do not fit into the periphery of the framing as manufactured.

The present invention is directed toward overcoming one or more of the problems set forth above.

SUMMARY OF THE INVENTION

In one aspect of the present invention, a frame is provided for mounting at least one heat exchanger in a vehicle, including a longitudinal side and a transverse side, fasteners on the sides adapted to fasten to the at least one heat exchanger between the sides, and supports on the sides adapted to secure to a vehicle to support the frame therein. At least one of the sides is adjustable in length in the direction of the side.

In one form, at least one of the sides is biased toward another of the sides for fastening the fasteners to the at least one heat exchanger.

In another form, the sides are plastic members, and a reinforcement is provided on at least one of the plastic members.

In still another form, the at least one side is infinitely adjustable in length, and in another form at least one side is incrementally adjustably in length.

In yet another form, the longitudinal and transverse sides include a pair of longitudinal sides extending between a pair of transverse sides, at least one of the pair of sides is adjustable in length in the direction of the pair of sides.

In one aspect, a first generally U-shaped frame member has two arms projecting on one of the longitudinal and transverse directions, a second generally U-shaped frame member has two arms projecting in the one of the longitudinal and transverse directions, and arm fasteners are adapted to selectively secure the two arms of the first frame member to the two arms of the second frame member whereby the sides of the one pair of sides have a selected length. In one further form, the two arms of the first frame member are substantially equal in length to one another, and the two arms of the second frame member are substantially equal in length to one another, and in another form the two arms of the first frame member are different in length than the two arms of the second frame member. In a second further form, a crosspiece is between the two arms of at least one of the first and second frame members. In a third further form, the first frame member is plastic and the second frame member is metal. In still another further form, the arms of the first frame member include channels along their length and the arms of the second frame member are received in the channels, and the first frame member is plastic and the second frame member is metal.

In another aspect, a first angle frame member has a pair of arms oriented in an L and a second angle frame member has a pair of arms oriented in an L, wherein one arm of the first angle frame member and one arm of the second angle frame member are adjustably securable to one another along their lengths to define the adjustable side.

In a further form, a third angle frame member has a pair of arms oriented in an L and a fourth angle frame member has a pair of arms oriented in an

L, wherein one arm of the third angle frame member and one arm of the fourth angle frame member are adjustably securable to one another along their lengths to further define the adjustable one of the longitudinal and transverse sides, and the other of the longitudinal and transverse sides is adjustable and defined by adjustably securable other arms of the first and third angle frame members and adjustably securable other arms of the second and fourth angle frame members. In a still further form, the first, second, third and fourth angle frame members are substantially the same configuration. In yet a further form, with each angle frame member, an angle crosspiece is between the L-oriented pair of arms. In yet a further form, with each angle frame member there is a slit at one end of the angle crosspiece adapted to receive the crosspiece of an adjacent angle frame member when the one arms of the angle frame members are adjustably secured in a position in which the crosspieces overlap.

In a further form, with each angle frame member, an angle crosspiece is between the L-oriented pair of arms. In a still further form, a slit in one angle crosspiece is adapted to receive the other crosspiece when the one arms of the frame members are adjustably secured in a position in which the crosspieces overlap. In yet a further form, the one arms of the frame members are adjustably securable in a position in which the crosspieces do not overlap. In a yet further form, the one angled crosspiece is associated with the first angle frame member and includes two legs spaced from front to back at least at the connection of the one angled crosspiece to the one arm of the first angle frame member, and the other angled crosspiece associated with the second angle frame member is arranged front to back to be received between the spaced legs of the one angled crosspiece.

In yet another form, the one arm of the first frame member is adjustably received in a channel defined by the one arm of the second frame member, and in a further form a locking member is provided for securing the one arm of the first frame member in a selected position in the channel defined by the one arm of the second locking member.

In still another form, the first angle frame member one arm is infinitely adjustable relative to the second angle frame member one arm.

In yet another form, a slit is defined in the one arm of the first angle frame member, and a fastening element is fixed relative to the second angle frame member and extends through the slit, the fastening element adapted to selectively secure to the first angle frame member.

In still another form, the first and second angle frame members define three sides of the frame, and a crosspiece securable to the first and second angle frame members defines a fourth side of the frame. In a further form, the crosspiece defining the fourth side is U-shaped and includes arms securable to the other arms of the first and second angle frame members.

In other aspects of the invention, a heat transfer device includes a frame as broadly described above, and at least two heat exchangers, with the frame fasteners biased toward the heat exchangers to fasten the at least two heat exchangers between the frame sides. In one form of this aspect of the invention, the heat exchangers are arranged side by side.

In yet other aspect of the invention, a heat transfer device includes a frame as broadly described above, and at least two heat exchangers, each including headers on their top and bottom, wherein the fasteners are on top and bottom sides of the frame and fasten the frame to the heat exchanger headers.

In still another aspect of the present invention, a heat transfer device includes a frame as broadly described above, and at least one heat exchanger, wherein the frame fasteners include an opening defined in the frame, a pin extending between the frame and the heat exchanger and the opening, and a vibration damping element between the pin and the defined opening.

In one form of this aspect of the invention, the opening is conically shaped, and the pin is shaped to correspond to the opening shape.

According to yet another aspect of the present invention, a heat transfer device includes a frame as broadly described above, and at least one heat exchanger, wherein the heat exchanger is substantially entirely secured to the frame by the fasteners, and the fasteners are elastic.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front perspective view of a heat transfer device incorporating the present invention;

Figure 2 is a rear perspective view of the Fig. 1 embodiment;

Figure 3 is an exploded view of the frame of Figs. 1-2;

Figure 4 is a perspective view of one frame member according to the present invention;

Figure 5 is an enlarged, exploded partial view of two cooperating frame members according to Figs. 1-3

Figure 6 is an exploded view of the heat transfer device of Figs. 1-3;

Figure 7 is another heat transfer device according to the present invention, illustrating the frame prior to fastening to the heat exchangers arranged in side by side position;

Figure 8 is an enlarged, partially broken-away detailed view of a fastening point between the heat exchanger and the frame;

Figure 9 is a front perspective view of the Fig. 7 heat transfer device supported on a vehicle frame with one heat exchanger omitted;

Figure 10 is an exploded perspective view of a third embodiment of a heat exchanger mount frame according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figs. 1-6 show a heat transfer device 10 according to the present invention, wherein a pair of heat exchangers 14, 16 are supported in a frame 20.

The frame includes four angle frame members 22, 24, 26, 28, each having a pair of arms 22a, 22b, 24a, 24b, 26a, 26b, 28a, 28b in an "L" orientation to one another and each generally defining different corners of a generally rectangular frame 20. One arm 22a, 24a, 26a, 28a of each frame member 22, 24, 26, 28 is suitably adjustably secured to another arm 24b, 26b, 28b, 22b, respectively, of an adjacent frame member 24, 26, 28, 22. For example, as illustrated, channels 36 may be defined in selected arms 22a, 24a, 26a, 28a, with the adjustable secured arms 24b, 26b, 28b, 22b of adjacent frame members suitably shaped to be slidably received in the channels 36.

It should thus be appreciated that the frame members 22-28 will cooperate to define a generally rectangular frame 20 having a longitudinal side 40 and a transverse side 42, both of which may be adjusted to accommodate different size heat exchangers depending upon the requirements of the vehicle. (The terms "longitudinal sides" and "transverse sides" serve merely to distinguish the sides and in no case says anything about their length or their orientation. Both sides, for example, can have the same length, and either side may be, for example,

horizontal or vertical. Moreover, it should re recognized that, in the Figs. 1-6 embodiment, the longitudinal and lateral sides 40, 42 are each defined by a pair of sides, with the longitudinal side 40 defined both by arms 22a and 28b and arms 24a and 26b and the transverse side 42 defined both by arms 22a and 24b and arms 26a and 28b.)

Suitable locking mechanisms 50 are provided to secure the frame member arms together in the desired length. For example, as perhaps best appreciated from Fig. 3, arms 22a, 24a, 26a, 28a each include a pair of aligned holes 52 on opposite sides of their channels 36 and the associated arms 24b, 26b, 28b, 22b received in those channels 36 include a slit 54 aligned with those holes 52. Suitable bolts 56 extend through the holes 52 and slits 54, allowing the arms 24b, 26b, 28b, 22b to slide within the channels 36 within limits, and to be positioned in selected infinitely variable (*i.e.*, stepless) positions between those limits. The arms 22a, 24b; 24a, 26b; 26a, 28b; 28a, 22b may be secured together in any selected position by tightening of the bolts 56, thereby squeezing the sides of the channels 36 together against the arm 24b, 26b, 28b, 22b held therein.

Each angle frame member 22, 24, 26, 28 includes an angle crosspiece or brace 60 having a yoke or fork configuration at one end defining a slit 64. The ends of the yoke configuration are secured on opposite sides of a slit 68 in the arm 22a, 24a, 26a, 28a defining the channel 36 so that, as perhaps best seen in Fig. 2, the angle frame member 22, 24, 26, 28 can be connected with arms 22b, 24b, 26b, 28b slidably received in the channels 36 and with the ends of the angle crosspieces 60 received in the arm slits 68 and, where the length of the sides 40, 42 is sufficiently short (as in Fig. 2), received in the slits 64 of overlapping angle crosspieces 60.

Supports 70 are suitably secured to the lateral sides 42 of the frame 10, as by nuts 74 and bolts 76 extending through (depending on the required height of the supports relative to the vehicle support frame) the slit 54 in the flat arm 28b and/or holes in the channel arm 22a. Suitable dampers 80 may be provided to minimize vibration.

As illustrated in Figs. 1-2 and 6, the heat exchangers 14, 16 are arranged side by side, with the headers or collecting tanks 82 at the top and bottom. It should be appreciated, however, that the collecting tanks could also, within the scope of the invention, be oriented vertically (*i.e.*, at the lateral sides 42). Though not shown, the core 84, 86 of the heat exchangers 14, 16 may be of any suitable type such as flat tubes extending between the headers 82 with plate or serpentine fins between the tubes. The heat exchangers 14, 16 may also operate with multiple passes, as can be provided by the inclusion of baffles in one or more header 82. In any event, though not drawn in the Figures to prevent clutter, the cores 84, 86 are such as to allow air to pass therethrough in the direction of arrow 88 (see Fig. 1), typically for cooling one or two phase fluids in the heat exchanger tubes.

Suitable fasteners 90 are also provided on the angle frame members 22, 24, 26, 28 and are adapted to secure the heat exchangers 14, 16 in the frame 20. As one simple example, the fasteners 90 may consist of raised members on the inside of the frame 20 which are received in recesses in the headers 82 of heat exchangers 14, 16 such that, when the frame 20 is sized so as to be closely around the heat exchangers 14, 16, the fasteners 90 will be received in the header recesses and block the heat exchangers 14, 16 from moving forward (*e.g.*, opposite the direction of the arrow 88 in Fig. 1) out of the frame 20.

It should be appreciated that each of the angle frame members 22, 24, 26, 28 may be identical, as should be apparent from Fig. 3 in particular. Further, these frame members 22, 24, 26, 28 may be readily adjusted to a variety of heights and widths to accommodate a wide variety of different size heat exchangers and different size compartments within which they must be mounted.

Fig. 7 illustrates another embodiment of the present invention, in which the frame 20' consists of two U-shaped frame members 100, 102 so that the frame 20' is adjustable in size in the vertical direction, but has a fixed width. The lower frame member 100 is suitably designed, for example, with reinforcing ribs 108, to be stable, with the supports 70' suitably fixed to the lower frame member 100 to take up bearing forces when supported (*e.g.*, with dampers 80) on a vehicle frame 110 as shown in Fig. 9. The lower frame member 100 may comprise plastic with the upper frame member 102 being formed of metal such as aluminum or steel sheets.

The downwardly oriented legs of the upper frame member 102 are suitably adjustable relative to the upwardly oriented legs of the lower frame member 100. Openings 112 in the lower frame member 100 may be selectively aligned with openings 114 in the upper frame member 102 and secured together in selected step-wise adjustable positions by a suitable fastener such as a screw or bolt or pin 118 inserted through selected aligned openings 112, 114. Still other fasteners could be used as well, such as shape-mated connections, like snap connections or the like.

One or more reinforcing crosspieces 120 (see Fig. 9) may also be provided between the arms of one or both of the U-shaped frame member 100, 102, with suitable space provided between the arms, such as a slit as with the first

described embodiment, to allow the frame members 100, 102 to be adjusted without interference from the crosspieces 120.

Two heat exchangers 14', 16' are illustrated in Fig. 7 in side by side arrangement in the frame 20' (with one of the heat exchangers 16' omitted for illustration purposes in Fig. 9), though it should be understood that frames 20' of this configuration could also support heat exchangers in front to back orientation (or both side by side and front to back orientation) (as could also be the case with all of the embodiments described herein). Suitable fasteners could be provided accordingly (*e.g.*, front and rear sets when front to back orientation is contemplated).

Fig. 8 illustrates an enlarged cutout of an elastic fastener 90' which may suitably be used with the present invention. The fastener 90' includes an opening 130 punched, for example, in the cross-strut 134 of the upper U-shaped frame member 102, and a conical collar 138 formed around opening 130. A pin 140 (see Fig. 7) is arranged on collecting tank 82' of a heat exchanger 14', and extends into opening 130, in which a vibration-damping element 144 is arranged between the pin 140 and the collar 138 of the opening 130. A plurality of such elastic fastener 90' (*e.g.*, containing a spring or rubber element) may be provided to stably secure the heat exchangers 14', 16' in position without need for any additional fastening to the frame 20'. Further, a certain bias of the frame members 100, 102 on the heat exchanger 14', 16' can be provided to enhance such fastening. A trough-like recess could also be provided, instead of the opening 130. Such fasteners 90' not only provide a vibration-reduced mounting of the heat exchangers 14', 16', but also allow for heat-related length changes. If a bias force is exerted on the heat exchanger by means of the framing, the elastic fastening should be designed so that heat-related length changes are also possible.

Fig. 10 shows another embodiment of the present invention, in which the frame 20", which consists of two generally L-shaped angle frame members 24", 26", such as may be similar to the frame members in Figs. 1-6 and separately shown in Fig. 4. Those two frame members 24", 26" themselves provide a three sided frame 20" which may be infinitely adjusted to different widths according to the needs of the particular installation. The frame 20" may be completed, if desired, with a fourth side by a third (U-shaped) frame member 140, or the fourth side may be left open. If a third frame member 140 is used, different sizes may be required depending on the width to which the two frame members 24", 26" are adjustably set. However, this is not a serious problem, since the upper frame member can be readily and conveniently made of sheet steel.

It should thus be appreciated that frames may be provided in a variety of configurations while still embodying the present invention whereby a variety of different size heat exchangers may be accommodated by a single frame. For example, according to the first described embodiment, the frame may be adjustable in length along both sides (longitudinal and lateral) via use of four angle frame members. Alternatively, the frame may be adjustable in length along one of the sides by use of two U-shaped frame members according to the second described embodiment. Further, the frame may be adjustable in length along one of the sides by use of two angle frame members, with a reinforcing crosspiece optionally usable according to the size, in accordance with the third described embodiment.

It should thus be appreciated that the present invention provides flexibility in use so that an entire series of vehicles can be equipped with heat transfer exchangers of varying sizes while using the same frame structure, thereby minimizing or eliminating the cost of manufacturing different size frames, and minimizing the inventory of frames which must be maintained. For example, the

ability to readily adjust the frame structure allows the same frame structure to be used for, for example, light, medium and heavy trucks, whereby production of those different size trucks can therefore proceed cost effectively. In light trucks, smaller heat exchangers are provided (because of the lower engine power) and the frame members may be pushed close together and then detachably joined in this position at their arms, so that they enclose, for example, the smallest possible surface. On the other hand, in heavy trucks with significantly larger heat exchangers, the detachable connection of the frame members allows the frame to be enlarged to provide the significantly larger surface required for those heat exchangers.

Still other aspects, objects, and advantages of the present invention can be obtained from a study of the specification, the drawings, and the appended claims. It should be understood, however, that the present invention could be used in alternate forms where less than all of the objects and advantages of the present invention and preferred embodiment as described above would be obtained.